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Patent Claims

1. A method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) for implementation in an arithmetic unit (4) of a sensor system (2) with at least one sensor (3), whereby the cost function depends on the respective state (x) to be measured and gives the deviation of an actual measured value from the calibrations as a function of the state (x) in order to determine the sought state (x) from its minimum,

is hereby characterized in that

-- a cost function is established, which indicates the deviation of an actual measured value from the calibration functions (curves or surface areas) as a function of the unknown system state (x),

-- for at least one predetermined approximation function of the cost function, which indicates the deviation of an actual measured value from calibration functions as a function of the unknown state, a selection of approximation regions is established (30), whereby the sum of the approximation regions covers the entire relevant state region,

-- in the selection of approximation regions, all local minima of the at-least one predetermined approximation function of the cost function are determined (40) within the state region (x), whereby the minimum is

determined in an approximation region by the sum of the start vector and a weighted difference of the measured value from the calibration as a function of the start vector, [and]

-- a determination of the global minimum (50) results from the comparison of the local minima.

2. A method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) for implementation in an arithmetic unit (4) of a sensor system (2) with at least one sensor (3), whereby the cost function depends on the respective state (x) to be measured and indicates the deviation of an actual measured value from the calibrations as a function of the state (x), in order to determine the sought state (x) from its minimum,

is hereby characterized in that

-- a cost function is established, which indicates the deviation of an actual measured value from the calibration functions (curves or surface areas) as a function of the unknown system state (x),

-- from a selection of approximation functions of the cost function, which indicate the deviation of an actual measured value from calibration functions as a function of the unknown state, an approximation function is selected, and a selection of approximation regions is established (30),

whereby the sum of the approximation regions covers the entire relevant state region,

-- in the selection of approximation regions within the state region (x), all local minima of the selected approximation function of the cost function is [are] determined (40), whereby the minimum is determined by the sum of the start vector and a weighted difference of the measured value from the calibration as a function of the start vector, [and]

-- a determination of the global minimum (50) results from the comparison of the local minima.

3. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to claims 1 or 2, further characterized in that the cost function contains a weighting of deviations of the measured value from the calibration based on the accuracy of the measured value or calibration.

4. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to one of the preceding claims, further characterized in that the system (1) is an air data system of an airplane and the following function is used as the cost function:

$$\chi^2 = [y-(c_p q_c+p_s)]^T\,[Cov(c_p)q_c^2+\sigma_p^2]^{-1}\,[y-(c_p q_c+p_s)]$$

5. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to one of the preceding claims, further characterized in that the system (1) is an air data system of an airplane and the following function is used for the minimum determination:

$$x = x_o + P\ H\ R^{-1}\ (x_o)[y-(c_p(x_o)q_{co}+p_{so})]$$

6. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to one of the preceding claims, further characterized in that in order to determine for the minimum, one proceeds from a random start vector x_o in the respective approximation region and the minimum is then determined by the sum of a start vector x_o and a weighted difference of the measured value from the calibration as a function of the start vector.

7. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to one of the preceding claims, further characterized in that in order to determine the minimum, a quadratic approximation of the cost function is used, and in order to determine of the minimum of the cost function, the minima in each approximation region of a selection of correspondingly established approximation regions are determined, whereby a determination of the local minimum results based on the quadratic approximation function and each local minimum x is determined

in the neighborhood of the selected grid points, starting from a start vector x_o, by the sum of the respective start vector x_o and a weighted difference of the measured value from the calibration as a function of the start vector.

8. The method for the determination of a state variable (x) from at least one sensor value by means of a cost function prepared for a measured value (y) according to one of the preceding claims, further characterized in that the approximation functions and the neighborhoods are established such that the approximation function possesses only one minimum in the neighborhood of the respective grid point and that the local minimum is determined by means of a gradient process.

9. A method for the implementation in an arithmetic unit of a sensor system according to one of the preceding claims, characterized in that the approximation function is a function, whose minima can be determined by means of analytical methods.

10. The method for the implementation in an arithmetic unit of a sensor system according to one of the preceding claims, further characterized in that the at-least one approximation function and the at-least one approximation region are produced in a recursive method prior to establishing the cost function.

11. A sensor system with at least one sensor (3) for the determination of a system state and with an arithmetic unit (4), whereby the arithmetic unit

(4) contains the method for the determination of a state variable from at least one sensor value according to one of the preceding claims.